Conceptual process and methodology aimed at developing complex social indicators used in demographic policy

Centre for population
studies at the
Bulgarian academy of sciences

National council for co-operation
on ethnic and demographic issues
at the Council of ministers of
the Republic of Bulgaria

COMMUNICATION STRATEGY OF THE REPUBLIC OF BULGARIA
FOR THE EUROPEAN UNION

FERTILITY IN BULGARIA AND STATE POLICY

Scientific conference with international participation
Sofia, 13 – 14 March 2009

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Proceedings of the
Scientific conference with international participation
"Birth encouragement: multi-sided practice of Government intervention in population reproduction – the Bulgarian and European experience"
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FOREWORD

The present edition is of selected papers of the scientific conference with international participation which took place in Sofia, 13-14 March 2009 and was organized by the Center of population studies [CPS] at the Bulgarian academy of sciences and the National council for co-operation on ethic and demographic issues at the Ministerial council of the Republic of Bulgaria.

Devoted to the fertility and the State role in the population reproduction it appears as the next scientific and public forum after a series of such annual conferences on demographic development of the country, discussing about the most acute problems as far as the present demographic crisis concerns and the needed measures of its overcoming. The presenting of scientific research position and formulating of policy-oriented issues are the main goals of these forums, started yet before the Bulgaria's accession to the European Union. The first such conference has been conducted in 2005 under the title "European future of Bulgaria and the population development". Scholars, politicians and experts in social practice focused on the global and European trend of population development and the demographic processes and structures in Bulgaria and its adequate population and family policy as well.

The next forum attracted the attention of the scientists and the competent bodies on the issues of ageing population. The partners of the Center of population, being the Ministry of labour and social policy and the National insurance institute lead to the enlargement of these issues till the very problems of consequences of the ageing, the appropriate policies and the social protection systems.

The third scientific conference held in 2007 was on the demographic and social issues of young generations in Bulgaria and their demographic behavior, the changes of values' system, attitudes to the relations in the family and towards the children. Organized by the Centre of population studies in co-operation with the Ministry of labour and social policy, the Agency of youth and sports, and the Institute of social values "Ivan Hadjiisky" and under the patronage of the President of the Republic of Bulgaria, this conference turned into a remarkable event of the scientific life, corresponding to the issues determining the demographic future of Bulgaria.

The 2008 forum reflected on the demographic processes impacting the State and reproduction of labour force. Its performance has been supported by the Economic and social council of the Republic of Bulgaria and the Ministry of labour and social policy. There have been discussed the present challenges of the home labour market and the country participation in the common European market accounting for the deteriorated demographic trend, the insufficiency of labour work and its ageing and qualitative dimensions, labour migration and regional distribution of human resources.

The conferences are a free floor for statements regarding theoretical and methodological issues and population policies and practices.

The mentioned herewith conference of 2009 deals with the fertility issues and the determinants of its fall particularly stressing on the Government role in population reproduction. This is the most discussable issues regarding population policies. During the transition period the State passed through the stage of distancing itself from population problem, than to the revaluation of its

position and finally to the adoption of particular Demographic Strategy of the Republic of Bulgaria 2006-2020 with clearly defined goal and priorities of population policy.

There participated representatives of the Bulgarian Academy of Sciences, many universities and state bodies and NGO's.

The Center of population studies is expressing its gratitude's to the famous scientists prof. Colem, prof. Dumont and prof. Maggino for their kind acceptance of our invitation to take part in the conference and present their studies, results and position regarding this issue of great importance for Europe.

This edition together with the invited papers includes selected papers of Bulgarian researchers, enhancing varieties of fertility topic and comparison with and between the European countries.

This is the first issues of the conferences edited in English by the aim of a larger audience to be informed about the Bulgarian population problems as well as the acceptance of the good experience and population policies practiced in Europe by the Republic of Bulgaria being a full member of the European Union.

Assoc. prof. PhD G. Mihova
Executive director of CPS

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3. **Philipov, D.** A cross-cohort analysis of the demographic policy efficiency. // S t a t i s t i k a [Statistics], 1993, No. 2, pp. 40-52. [In Bulgarian]
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CONCEPTUAL PROCESS AND METHODOLOGY AIMED AT DEVELOPING COMPLEX SOCIAL INDICATORS USED IN DEMOGRAPHIC POLICY

Filomena Maggino

Summary: Measuring social phenomena requires a multidimensional and integrated approach aimed at describing the health of societies through a complex multifaceted and compound methodology.

The aim of this work is to reveal some important methodological aspects and issues that should be considered in measuring social phenomena in quantitative perspective and in developing indicators useable in demographic policy.

The purpose is to focus on, to examine closely and to investigate the conceptual issues in defining and developing indicators and the methodologies and operative issues in managing the complexity of the obtained observation, integrating objective and subjective aspects of the reality.

Introduction

Any measuring process needs basic principles to be clarified in order to proceed with. Three different measuring processes can be identified.

Measuring by fundamental process: measuring process does not refer to previous measures (operative process) but do reflect natural laws (constitutive process). Assessing a fundamental process requires a theory to be constructed and inspected. Characteristics that can be measured through a fundamental process are length, volume, and so on.

Measuring by deriving process: measuring process is based upon other measures, related to each other through a wider

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Filomena Maggino, professor in statistics, Florence University, Italy

theory allowing algorithms to be defined and applied on fundamental measures; characteristics that can be measured through a fundamental process are density (relationship between mass and volume), velocity (relationship between space and time).

Measuring by defining process: measuring process is carried out in consequence of (and consistently with) a definition confirmed through relationships recorded between observations and defined concepts. All the measures applied in social sciences belong to this category (*socio-economic status*, *capacities*, etc.). This measuring process requires indicators to be defined. With reference to this, we have to point out that, even though "**indicator**" and "**index**" are terms often used in an interchangeable way, they have different origins and meanings: the former comes from the late Latin word "indicator" that means "who or what indicates" and the latter comes from the Latin word "index", which means "any thing that is useful to indicate".

In statistics, on one hand, "index" represents historically a very generic word applied with multiple meanings; on the other, "indicator" represents a more recent term indicating as seen above indirect measures of economic or social phenomena not directly measurable. In this perspective, indicators can be defined as measures of events that are not simply crude statistical data since they represent measures organically connected to a conceptual model aimed at the knowledge of different aspects of reality. In other words, a generic index value can be converted into an "indicator," when its definition and measurement occur in the ambit of a conceptual model and are connected to a defined aim. Consequently, the measurement process requires a design allowing indicators to be defined. The design can be represented by the following stages:

1. Defining the conceptual framework	⇨	Comprehensive approach
↓		
2. Developing the indicators	⇨	Logical modeling (hierarchical design)
↓		
3. Managing the complexity	⇨	Analytical process (multi-stages and multi-techniques)
↓		
4. Framing the complexity	⇨	Developing a system of indicators

1. Defining the conceptual framework. Different conceptual frameworks can be identified in order to measure social phenomena. As we will see, a **comprehensive approach** is needed allowing objective and subjective information to be integrated. The possibility to integrate objective and subjective information requires a solid methodological structure as a consequence of a clear theoretical construction assuming the correct perspective of integration. This means that the methodological structure for integration is based upon a clear conceptual framework able to depict

• a shared definition of the two perspectives and of their relationships

• a conceptual perspective of integration that takes into account the complexity of the observed reality.

2. Developing the indicators. Indicators should be developed through a **logical modelling process** conducting from concept to measurement. The process allows the complexity of the observation to be consistently managed through the adequate perspective.

3. Managing the complexity. In order to manage the complexity of the obtained data structure aimed at integrating different elements (e.g. objective and subjective) a "composite" **analytical process**, defined by subsequent steps (*multi-stages*) and by different analytical approaches (*multi-techniques*) is needed.

4. Framing the complexity. The previous stage helps in reducing the complexity. However, the obtained data structure needs a frame allowing the conceptual framework to be put in a concrete form. This frame can be found in the "**system of indicators**" approach. Moreover, this requires (i) an effective organizational context relying on technological supports and allowing data to be managed; (ii) structured and systematic data, observed in long-term longitudinal perspective. This is particularly demanding with reference to subjective data, which require a great use of resources (beyond a solid survey research methodology).

1. Defining the conceptual framework: towards a comprehensive approach

Many theoretic models have been developed and try to explain and to operationalise different definitions and concepts of social phenomena. The distinction among all the different definitions can be explained by the different structures of life values. The different concepts that can be used in order to define social phenomena can be distinguished with reference to different perspectives, referring mainly to **processes**, **conditions**, or **goals**. Each approach can show strengths and weaknesses, can adopt concepts and/or information which can be partially or completely coinciding or overlapping the ones adopted by the others.

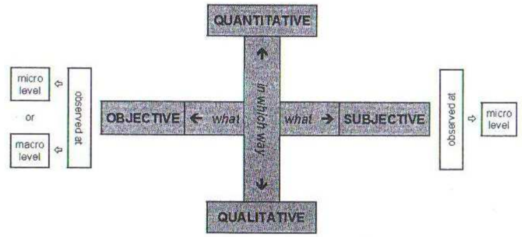
Consequently, in order to measure social phenomena it is difficult to adopt just one solution and a multidimensional definition and a comprehensive approach need to be assessed.

A good and healthy society is that in which each individual has the possibility to participate to the community life, to develop capabilities and independency, to have adequate possibility to choose and control his/her own life, and to be treated with respect in a healthy and safe environment and by respecting the opportunities of future generations. Whichever is the conceptual framework, it requires a multidimensional approach, requiring both objective and subjective information observed at different levels (micro and macro). In other words, what emerges clearly is that a comprehensive approach needs to integrate objective information observed at micro-individual level and macro-societal level and subjective information.

In policy perspective, the need for subjective indicators arises during (i) the assessment of policy results and (ii) the selection of policy objectives (Veenhoven, 2002).

1.1. Objective and subjective components

Sometimes, the distinction between objective and



subjective is considered equivalent to the distinction between quantitative and qualitative. Of course, this is not correct. In our perspective, we can summarize the two dyads as follows:

1. "objective subjective" refers to what we are going to observe

2. "quantitative qualitative" refers to the methodological approach applied in order to observe the previous dimensions

1.1.1. Definition of "objective" and "subjective"

The necessity to study and comprehend facts through the observations of different components with reference to two different perspectives of observation, traditionally classified in terms of objective and subjective components is felt in many research fields concerning social phenomena from economics to education. The identification of the two aspects objective and subjective represents in itself a reduction of the reality. Even if the reduction is needed for measuring reasons, it should not degenerate into a contraposition between two different "realities." The reality will be inevitably distorted by contemplating just one of the two aspects. Before defining the two components, it could helpful trying to clarify here the meaning of "**objective**" and "**subjective**" adjectives consistently to different concepts:

1. Conceptual framework defined in order to observe a reality. In this case, it is difficult to identify an objective model since the conceptual framework is always yielded by a "subjective" hypothesis and view of the world made by the researcher. Concerning this, as Michalos (1992) noticed, many models defined to observe a reality are only apparently neutral. Actually, the conceptual model is represent only a "small window" through which it is possible to see only some facets of the reality (*reductionism*); in this sense, the view is politically and socially

distorted and can condition knowledge, evaluations, choices, actions, and policies.

2. Measurement and analysis method, in this case the adjectives refer to the adopted methodologies to study the characteristics defined in the ambit of the conceptual framework: the researcher should pursue objective methodologies.

3. Observed/measured characteristics, in this case the adjectives refer to the kind of information which has been defined in the ambit of the conceptual framework and subsequently objectively measured and analysed. In order to make the distinction between objective and subjective characteristics more clear from the operative point of view, we can refer to the source called *unit* on which the characteristic of interest is measured. The units can be represented by individuals, institutions, social groups, services, administrative areas, geographical areas, nations, and so on. Consequently, we can distinguish between *objective information* (collected by observing reality) and *subjective information* (collected only from individuals).

Objective components

In synthetic terms, objective components of quality of life refer to the conditions in which each individual lives (health, working conditions, environmental situations, and so on). They can find different definition according to two major perspectives:

- micro-level, referring and taking into account the individual level
- macro-level, concerning and taking into account economic, demographic, geographical, administrative or social level.

Micro-level

Among the objective characteristics observed at individual level, we can mention:

• *demographic and socio-economic characteristics* (sex, age, civil status, household, educational qualification, professional condition, income, birthplace, residence, domicile, geographical/social mobility, etc.);

• *life style* that can be defined by activities (work, hobby, vacation, volunteering, sport, shopping, etc.), engagements (familiar, working, social, etc.), and habits (schedule, using of public transport and of means of communication, diet, etc.);

• *observable knowledge and skills*;

Observable behaviours, past and present (maybe related to the future ones).

One of the notions that can help in differentiating generic individual information from subjective information is that the latter can be observed only by/from the subject his/herself, in other words does not admit *proxy* person.

Macro-level

It is difficult to make an inventory of all possible objective characteristics definable and observable at macro level because they are different depending on the observed and studied field. Aspects concerning environmental conditions can represent examples. The *objective component at macro level* generally focus on social, economic and health contexts including observable, for example, through indices of economic production, literacy rates, life expectancy, natural and urban environmental indices, political indices, and so on.

Subjective components

The idea of subjective information is sometime restricted to a generic idea of "perception". In order to make clear the subjective components, it is important referring to the traditional

distinction of "subjective characteristics" in three content areas (Nunnally, 1978):

• abilities, that concern the capacity in performing different tasks (*performance*, that is evaluated with reference to specified criteria); the abilities can be intellectual (usually thought of as those forms of abilities that are important for scholarly accomplishment and scientific work) or special (usually thought to be important for mechanical skills, artistic pursuits, and physical adroitness); among the abilities we can mention the verbal comprehension and fluency, the numerical facility, the reasoning (deductive and inductive), the ability to seeing relationships, the memory (rote, visual, meaningful, etc.), the special orientation, the perceptual speed;

• personality traits, that can be defined as the psychological characteristics that determine the organizational principles and that reflects the way through which an individual reacts to the environment (*locus of control*, ego, introversion, self-esteem, identification, etc.); in this perspective, some overlapping categories can be identified: social traits, motives, personal conceptions, adjustment, personality dynamics;

• sentiments, generic terms referring to: *interests*; *values*, *attitudes*, concerning feelings about particular objects; traditionally, attitudes are defined as composed by three components, (i) cognitive (beliefs, evaluations, opinions), (ii) affective (feelings, emotions, perceptions and self-descriptions), and behavioural (actual actions and intentions).

1.1.2. Relationships between subjective and objective components

In order to make the observation, analysis, and integration of the two perspectives meaningful, a model is needed that is able to recompose the unity of the reality. In particular, the model has to provide:

1. a clear definition of the two components

2. a clear conceptualisation of the relationships between the two components.

Since it is impossible and undesirable to consider one perspective completely separated from the others, it appears quite clear that the integration between the components represents the most valid and complete approach in order to study quality of life, by interrelating and combining individual living conditions and subjective components by considering also values, aspirations and expectations (*mixed model*).

Synthetically, the **integrating model** is particularly required with reference to measuring and interpreting social phenomena. As previously stated, objective characteristics can be seen in terms of resources and conditions that individuals can use in order to improve their lives and to pursue their life projects. In this sense, the objective approach makes the social indicators model and Sen's capability model very similar. In this sense, the terms "objective" and "subjective" should be respectively replaced, according to Erikson (1993), with the terms "descriptive" and "evaluative."

Some assumptions have to be made concerning the relationship between the two components. In a broad simple outline, two perspectives can be alternatively defined:

1. objective component at macro level can be considered an antecedent with respect to subjective aspects. In this case, objective indicators (input) can be interpreted in terms of contextual conditions that can explain the subjective indicators (output)

2. objective quality of life conditions at macro-level and subjective quality of life (perceptions) are independent; perceptions are influenced by individual characteristics and not by the objective living conditions. In this case, subjective indicators (input) can be considered as important component driving policy goals in order to improve objective conditions.

A particular approach looks at integration between objective and subjective indicators by using the logic and the perspective of *social epidemiology*. This perspective can be defined as the systematic and comprehensive study of health, well-being, social conditions or problems, and their determinants.[1]

Traditionally, social epidemiology is defined as the combination of epidemiology (the study of the distribution and determinants of disease and injury in human populations) with the social and behavioural sciences in order to investigate social determinants of population distributions of health, disease, and well-being, rather than treating such determinants as mere background to biomedical phenomena (Krieger, 2002).

The principal concern of social epidemiology is the study of how society and different forms of social organization influence individuals' and populations' well-being. Social epidemiology goes beyond the analysis of individual risk factors to include the study of the social context in which the well-being/ill-being phenomenon occurs (in Epidemiological Bullettin, 2002). Even if social epidemiology is strictly related to the definition and identification of "social problems", (e.g. obesity, infectious diseases, violence, child abuse, drug use, and so on), in our viewpoint this approach turns out to be interesting also in the positive perspective of promoting quality of life (by involving not only the concept of "risk" but also the concept of "resource") since it considers both micro (personal behaviour) and macro trends in the social structure (distribution of wealth, social resources, and so on).

This perspective can help in explaining the path between exposure to social characteristics of the environment (with special attention to inequalities) and its effects on well-being by involving concepts and techniques that require the use of multidisciplinary approaches in order to analyse complex social problems.

In the traditional language of social epidemiology, "risk factors" are behaviours, attributes, individual characteristics, and exposures that may increase the probability of a specific outcome (Krieger, 2002). In order to identify risk factors, a central focus is implementing what we know about a particular condition in order to maintain and improve well-being. Inherent in this definition is the equal emphasis that we can give to objective conditions and subjective conditions as determinants of well-being. The approach of social epidemiology reflects the understanding that social variables or conditions can lie on either side of the equation determining which factors affect well-being. They can be independent variables, which are the characteristics hypothesized to explain the phenomenon. They can also be the social condition or outcome that we are trying to understand, or the dependent variable. For example, depression can be a risk factor for some diseases or social conditions, such as alcohol abuse or child neglect. It can also be the outcome of particular living conditions.

2. Developing the indicators

The hierarchical design

In order to develop indicators, a logical design needs to be defined. Given its features, this logical design is defined

hierarchical, since each component is defined and finds its meaning in the ambit of the preceding one. The components defining the **hierarchical design** are (i) the conceptual model, (ii) the areas to be investigated, (iii) the latent variables, and (iv) the elementary indicators.

Conceptual model. The definition of the conceptual model represents a process of abstraction, a complex stage that requires the identification and definition of theoretical constructs that have to be given concrete references of applicability. In social sciences, the description of concepts varies according to (i) the researcher's point of view, (ii) the objectives of the study, (iii) the applicability of the concepts, (iv) the socio-cultural, geographical, historical context. Concerning this, we can refer to concepts like health, education, well-being, income, production, trade, etc. The process of conceptualisation allows us to identify and define:

1. the model aimed at data construction,
2. the spatial and temporal ambit of observation,
3. the aggregation levels (among indicators and/or among observation units),
4. the condensing model of the elementary indicators and of the techniques to be applied for this (weighting criteria, aggregation techniques, etc.),
5. the interpreting and evaluating models.

Areas. The areas (in some cases named "pillars") define in general terms the different aspects that allow the phenomenon to be clarified and specified consistently with the conceptual model. The process of defining areas can be long and exacting, especially with complex constructs, and requires an analysis of literacy review.

Latent variables. Each variable represents one of the aspects to be observed and confers an explanatory relevance onto the corresponding defined area. The identification of the latent variable is founded on theoretical assumptions (e.g. homogeneity, dimensionality) and empirical statements so that the defined variable can reflect the nature of the considered phenomenon consistently with the conceptual model. However, even if we are able to identify a variety of diverse variables, we have to accept the idea that maybe no set of variables can perfectly capture the concept of social or economic well-being (Sharpe and Saltzman, 2004).

Elementary indicators. Each elementary indicator (item, in subjective measurement) represents what can be actually measured in order to investigate the corresponding variable. This means that each observed element represents not a direct measure of the variable but an **indicator**[2] of the reference variable (DeVellis, 1991). The hierarchical process allows a meaningful and precise position to be attributed to the indicator inside the model. In other words, each indicator takes on and gains its own meaning, and consequently can be properly interpreted because of its position inside the hierarchical structure: each indicator represents a distinct component of the phenomenon within the hierarchical design. The possibility to define and to consider alternative forms for each indicator has to be evaluated. According to a simple and weak strategy, each latent variable is defined by a single element (**single indicator approach**). This strategy, applied because of its thrifty and functional capacity, requires the adoption of robust assumptions. The adoption of single indicators presents a risk since it is not always possible to define the direct correspondence between one latent variable and one indicator. In other words, the variable is not always directly observable through

a single indicator. In fact, defining and adopting the single indicator approach can produce a wide and considerable amount of error that leads to problems concerning:

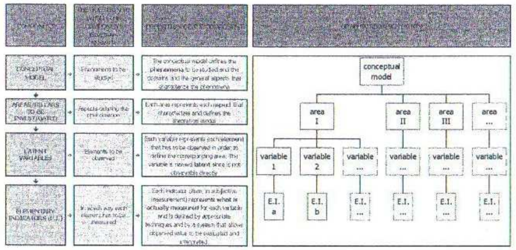
1. precision (*reliability*), since the measurement through one single indicator is strongly affected by random error;

2. accuracy (*validity*), since the chance that one single indicator can describe one latent complex variable is highly dubious and questionable;

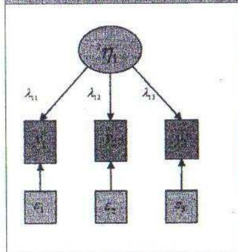
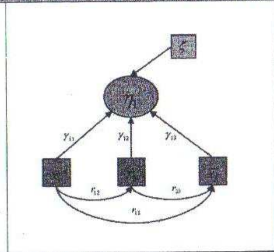
3. relationship with the other variables;

4. discriminating and *differentiating* among observed cases.

That is why, in many cases, the presence of complex latent variables requires the definition of several elementary indicators. This can be done by adopting the **multiple indicators approach**, which considers the multiple indicators as *multiple measures* (Sullivan & Feldman, 1981). Multiple indicators contribute to the measurement of the major aspects of the variable since each elementary indicator corresponds to one particular aspect of the latent variable. This approach allows variability of the defined



Models of measurement

	
Reflective approach	***Formative approach***
The reflective specification implies that $y_i = \lambda_i^\eta + \varepsilon_i$ where η - a latent variable $y_1, y_2, \dots, y_n$ - a set of observable indicators λ_i - the expected effect of η on y_i ε_i - the measurement error for the *i*-th indicator (i=1, 2, …, n). For $i \neq j$, it is assumed that $COV(\eta, \varepsilon_i) = 0$ $COV(\varepsilon_i, \varepsilon_j) = 0$ $E(\varepsilon_i) = 0$	The formative specification implies that $\eta = \gamma_1 x_1 + \gamma_2 x_2 + \dots \gamma_n x_n + \zeta$ where γ - the expected effect of x_i on η ξ - a disturbance term with $\mathrm{COV}(x_i, \zeta) = 0$ $E(\zeta) = 0$

latent variable to be covered. In addiction, this approach allows the problems produced by the single indicators approach to be avoided, or at least for their significance and weight to be reduced. In technical terms, the complete group of elementary indicators referring to one variable represents a *set of indicators*, while the complete group of indicators defining an area are called *thematic indicators*.

A further component of the hierarchical design definition is represented by the relationships between:

1. Latent variables and the corresponding indicators: these relations define the **measurement model**, which will be discussed below. Consistently with the measurement model, also the relationship between the *elementary indicators* should be defined In this perspective, two different states can be identified:

1. indicators are related to each other and relate to the same latent variable (in other words, they contribute to the definition of same variable); in these cases, the indicators are called *constitutive*;

2. indicators are not related to each other and relate to different latent variables; in this case, the indicators are called *concomitant*.

3. Latent variables for a given area: these relations are defined in the ambit of the conceptual model and identify the structural pattern (**relating model**). Defining these relationships is crucial, for example, in the perspective of integrating objective and subjective information.

The following table represents and summarizes the hierarchical design and its components.

3. Conceptual approaches to indicators definition: reflective and formative

The measurement model can be conceived through two different conceptual approaches (as represented in the following figure) (Blalock, 1964; Diamantopoulos & Siguaw, 2006):

• Models with reflective indicators (referring to the *top-down* explanatory approach). In this case, latent constructs are measured by indicators assumed to be *reflective* in nature. In other words, the indicators are seen as functions of the latent variable, whereby changes in the latent variable are reflected (i.e. manifested) in changes in the observable indicators.[3] Structural relationships are identified among latent constructs by statistically relating covariation between the latent constructs and the observed variables or indicators, measuring these latent, unobserved constructs. If variation in an indicator X is associated with variation in a latent construct Y, then exogenous interventions that change Y can be detected in the indicator X. Most commonly this relationship between construct and indicator is assumed to be *reflective*. That is, the change in X is a reflection of (determined by) the change in the latent construct Y. With reflective (or *effect*) measurement models causality flows from the latent construct to the indicators.

		'Correct' auxiliary theory	
		reflective	formative
Choice of the perspective	reflective	*correct decision*	**Type I error**
	formative	**Type II error**	*correct decision*

• Models with formative indicators (referring to the *bottom-up* explanatory approach). In this case, indicators are viewed as causing rather than being caused by the latent variable. The indicators are assumed to be *formative* (or causal) in nature. Changes in formative indicators, as firstly introduced by Blalock (1964), determine changes in the value of the latent variable. In

other words, a construct can be defined as being determined by (or *formed* from) a number of indicators. In this case, causality flows from the indicator to the construct. An example is socio-economic status (SES), where indicators such as education, income, and occupational prestige are items that cause or form the latent variable SES. If an individual loses his or her job, the SES would be negatively affected. However, saying that a negative change has occurred in an individual's SES does not imply that there was a job loss. Furthermore, a change in an indicator (say income) does not necessarily imply a similar directional change for the other indicators (say education or occupational prestige).

Traditionally, the reflective view is seen related to the development of scaling models applied especially (as we will see) in subjective measurement (*scale construction*), whereas the formative view is commonly seen in the development of *composite indicators* based on both objective and subjective measurements.

The distinction between formative and reflective measures is important because proper specification of a measurement model is necessary before meaning can be assigned to the relationships implied in the structural model. In choosing the measurement perspective, four different situations can be theoretically identified: (Diamantopoulos & Siguaw, 2006) as represented in the following table.

Two outcomes are desirable and correspond to the correct adoption of the measurement perspective (operationalisation) following the correct conceptualisation of the construct of interest. The other two outcomes correspond to wrong choices. In particular, two type of error can occur:

• Type I occurs when a reflective approach has been adopted although a formative approach would have been theoretically appropriate for the construct;

• Type II occurs when a formative approach has been adopted even if the nature of the construct requires a reflective operationalisation (an index construction procedure is adopted in place of a scaling model). This error can lead to identification problems.

Managing the complexity of the model

The consistent application of the hierarchical design produces a complex data structure. The complexity refers to:

1. the *elementary indicators*, identified for each variable (except those measured by single indicators)

2. the observed *cases/units*

3. the *variables*: according to the hierarchical design, several variables are defined

Consequently, the logical structure of data requires a complex organization and management, in which three corresponding data dimensions can be observed. In order to manage the complexity, each dimension may require a particular treatment, consistently with the conceptual model. In particular:

1. elementary indicators may require to be aggregated in order to construct complex indicators (aggregation of elementary indicators)

2. Observed units may require to be aggregated in macro-units

3. defined variables may require to be analysed through particular analytical approaches aimed at relating them in a comprehensive model.

3.1. The multi-stage multi-technique approach

In order to manage the complexity, four stages can be identified:

1. aggregating elementary indicators, according to the reflective or formative approaches (*construction of complex indicators)* at micro level

2. adequately relating variables by identifying the proper analytical approaches (e.g. integrating / merging objective and subjective indicators), consistently with the level of analysis (micro)

3. aggregating observed units (*definition of macro-units*) in order to lead the information observed at micro-level to the proper macro-level results; identifying the proper aggregation criterion should take into account the nature of measured characteristics (e.g. compositional, contextual, and so on) requiring different analytical approaches

4. adequately relating variables by identifying the proper analytical approaches (e.g. integrating / merging objective and subjective indicators), consistently with the level of analysis (macro)

3.2. Aggregating indicators: creating complex indicators

In order to better manage the complexity of the measured data, analytical models are required providing for significant data aggregations at different levels in order to ensure correct and different comparisons, transversal (between groups, regions) and longitudinal at both micro and macro levels.

In other words, the complexity of this structure can be reduced by defining and applying additional models. The purpose of these models is through the definition and adoption of particular assumptions to condense and synthesize the dimension by referring to the *multiple measures*.

The construction of complex indicators should be consistent with the adopted measurement model. In this context, the traditional distinction between formative and reflective is particular important since aggregation of indicators has to be consistently accomplished. In other words, indicators can be aggregated into complex structure through a consistent methodology according to two different criteria:

1. *Reflective criterion* (homogeneity), which can be adopted when the elementary indicators to be aggregated refer to the same latent variable; in this case, the condensed value is obtained by applying an appropriate scaling model that can produce a synthetic indicator.

2. *Formative criterion* (heterogeneity), which can be adopted when the aggregation is obtained by indicators (elementary and/or synthetic) that are not necessarily related to each other (in a statistic sense); in this case the aggregated indicator is obtained by applying the appropriate index construction procedure. The aggregated indicator is named composite indicator; in particular cases, the composite indicator is called comprehensive/summary indicator when constructed with the intention of being exhaustive with reference to a certain construct or reality.

In both cases, the condensation of elementary indicators, considered multiple measures, produces new synthetic values. Each synthetic indicator tries to re-establish the unity of the described concept described by the corresponding latent variable.

3.2.1. Reflective approach: statistical rationale

The procedure aimed at aggregating has to take into account the main specific properties of the reflective indicators,

which can be synthesized as follows (Diamantopoulos & Winklhofer, 2001):

1. indicators are interchangeable (the removal of an indicator does not change the essential nature of the underlying construct),
2. correlations between indicators are explained by the measurement model,
3. internal consistency is of fundamental importance: two uncorrelated indicators cannot measure the same construct,
4. each indicator has error term,
5. The measurement model can be estimated only if it is placed within a larger model that incorporates effects of the latent variable.

As a result, assessment of reliability and validity can be accomplished through a statistical approach consistent with the traditional specification used in **factor models**, where an observed measure is presumed to be determined by a latent factor and a unique factor. Reflective measures are presumed to be sampled from the domain of the latent construct. The relationships between latent variables can be inferred only when the significant relationships between indicators and the corresponding latent variables are observed (Bartholomew & Knott, 1999; Bohrnstedt & Knocke, 1994; Lazarsfeld & Henry, 1968; Long, 1993a; Netemeyer et al., 2003, Tucker & McCallum, 1993).

The formative specification is based upon the assumption that the total variance of each indicator represents the sum of three uncorrelated components:

1. common variance, portion of the total variance that is explained by the presence of the latent variable (ξ) and is measured by the correlation that each indicator registers with each of the

other indicators of the same latent variable (*common variance*);

2. specific variance, portion of the total variance that is not explained by the latent variable and is not correlated with the other indicators; together with the previous component composes the *reliable variance*;

3. Error, portion of the total variance that is not correlated with the previous ones and defines the *unreliable variance*.

In the ambit of the factor model, the interested is concentrated on the estimation of common variance. Specific variance and error are not estimated and are jointly considered as unique variance (*uniqueness* δ^2).

Generally, in a factor model more latent variables are defined. This means that almost never an indicator is explained by a single latent variable but instead can be described through a linear combination of latent variables (*common factors*). Consequently, the common variance represents the portion of the total variance jointly explained by the latent variables (*communality* h^2_{xi}).

The goal is to estimate for each indicator not only the total amount of communality but also the portions of communality that can be ascribed to the latent variables.

Actually, the consequent procedure leads to evaluate the load of the latent variable ξ_j on indicator x_i. This value is expressed by the *factor loading* $\lambda_{xi\xi j}$, which represents the saturation of each indicator with respect to the corresponding latent variable.

Since a squared correlation represents the proportion of variability that is accounted for by that relationship (coefficient of determination R^2), a squared *factor loading* represents the amount of variability that is accounted for by the corresponding latent

Stages	Perspectives		Levels of analysis	Analytical Issues
(i)	Aggregating elementary indicators	Creation of complex indicators by aggregating elementary indicators	From elementary indicators to complex indicators	• Reflective approach → synthetic indicators • Formative approach → composite indicators
(ii)	Relating variables	Understanding relationships between characteristics in order to integrate / merge information (e.g. objective and subjective)	Micro level	Different solutions (consistently with conceptual framework)
(iii)	Aggregating observed units	Creation of macro-units by aggregating elementary units	From micro units to macro units	Following - homogeneity criterion - functionality criterion
	Relating variables	Understanding relationships between characteristics in order to integrate / merge information (e.g. objective and subjective)	Macro level	Different solutions (consistently with conceptual framework)

variable (or factor). Consequently, for indicator x_i, communality h^2_{xi} represents the sum of the squared *factor loadings* of the latent variables (factors):

$$h^2_{xi} = \lambda^2_{xi\xi 1} + \lambda^2_{xi\xi 2} + \ldots + \lambda^2_{xi\xi m}$$

where m = number of latent variables.

The basic assumptions of the factor model can be synthesized as follows:

- indicators are linearly related;
- correlations between indicators can be interpreted only by the presence of latent variables;
- total variance of each indicator can be expressed as a function of (i) latent variables or factors (*communality*), and (ii) individual indicator characteristics (*uniqueness*);
- errors and disturbance factors are not interrelated and are not correlated with latent variables.

3.2.2. Formative approach: statistical rationale

In formative perspective, a concept is assumed to be defined by, or to be a function of, its measurements (identified indicators). In other words, the measures are formative when the latent variable is defined as a linear sum of set of measurements.

The formative specification implies the following relationship

$$\eta = \gamma_1 x_1 + \gamma_2 x_2 + \ldots + \gamma_n x_n + \xi$$

Where

η – Latent variable

x_i - indicator i

γ_i - the expected effect of x_i on η

ξ - disturbance term

The procedure aimed at aggregating has to take into account the main specific properties of the formative indicators, which can be synthesized as follows (Diamantopoulos & Winklhofer, 2001):

1. the indicators are not interchangeable (omitting an indicator is omitting a part of the construct),

2. the correlations between indicators are not explained by the measurement model,

3. there is no reason that a specific pattern of signs (i.e. positive vs. negative) or magnitude (i.e. high vs. moderate vs. low); in other words, internal consistency is of minimal importance: two uncorrelated indicators can both serve as meaningful indicators of the construct,

4. Indicators do not have error terms; error variance is represented only in the disturbance terms ξ

Consequently, assessment of reliability and validity can be accomplished through a statistical approach consistent with a principal components specification, where the latent variable is defined as a linear combination of elementary (manifest) indicators. While fundamental equation of the component model is

$$\sigma^2_{x_i} = \sum_{j=1}^{m} \lambda^2_{x_i \xi_j} + \delta^2_{x_i}$$

That is, linear combination of factor weights (λ, *loading*)

explains variance of each elementary indicator x_i, principal components approach is based upon a different specification. The step-by-step procedure for constructing synthetic (composite) indicators from formative indicators is described later. In defining the procedure, four critical issues must be considered (Diamantopoulos & Winklhofer, 2001): (i) content specification, (ii) indicator specification, (iii) indicator collinearity, and (iv) external validity.

Another approach is to include some reflective indicators and estimate a multiple indicators and multiple causes (MIMIC) model (Diamantopoulos & Winklhofer, 2001).

Particular formative approach: the composite indicators

Elementary indicators defined through a formative approach can be summarized through a process aimed at constructing **composite indicators**. The obtained composite indicator synthesizes a number of values expressed by the indicators that compound it (Nardo et al., 2005a/b; Sharpe & Salzman, 2004) and re-establishing the unity of the concept described in the hierarchical design. The aggregating process allows to obtain not a faithful description of the reality, but an "indication" that will be more or less accurate, meaningful, and interpretable depending on the defined hierarchical design and the applied methodology. In other words, the composite indicators are aimed at describing synthetically a reality, which is and remains complex. The methodology aimed to construct composite indicators requires specific techniques aimed at

1. verifying the dimensionality of selected elementary indicators (*dimensional analysis*)

2. defining the importance of each elementary indicator to

be aggregated (*weighting criteria*)

3. identifying the technique for aggregating the elementary indicators values into synthetic indicators (*aggregating-over-indicators techniques*)

4. Assessing the robustness of the synthetic indicator in terms of capacity to produce correct and stable measures (*uncertainty analysis, sensitivity analysis*)

5. assessing the discriminant capacity of the synthetic indicator (*ascertainment of selectivity* and *identification of cut-point or cut-off values*)

3.3. Aggregating observed units: defining macro-units

The multidimensional approach requires the evaluation of multiple aspects observed at different levels (individual, community, national, and global). Consequently, the integration needs to take into account the different levels at which information is collected and has to be analysed. In fact, some characteristics are observable only at macro level, others can be observed at micro level.

In order to pursue the goal of integration, we need to lead information to be analysed at the same level. This means that if the

		level of observation	
		micro	macro
information	objective	individual living conditions (i)	population (i) or territory (ii) information
	subjective	subjective well-being	*not observable*

interest is to obtain a composite picture (e.g. national), the information collected at micro level needs to be in someway aggregated to the proper scales (spatial or temporal) in order to accomplish a correct analysis integrating objective and subjective data.

Actually, the problem of aggregation concerns the reduction/condensation of values observed at lower levels (usually, individuals) to higher levels (e.g. geographical areas) among which comparisons will be carried out. This problem involves both objective and subjective indicators, with different solutions.

The aggregation of objective information (observed at micro or macro level) to the proper scale can be obtained through different **criteria**:

(i) "compositional", when information refers to population (e.g. proportion of people living in poverty),

(ii) "contextual", when information refers to area/territory (irreducible to the individual level), for example, income distribution, population density, or absence of facilities, such as supermarkets, libraries, or health centres.

The aggregation of subjective information requires individuals' values to be aggregated in order to produce new synthetic values to be assigned to new meaningful units identified according to different kind of scales (typologies, geographical areas, administrative territories, etc.). This task is not an easy one and requires different approaches and particular attention and concern. This aggregation perspective is particularly delicate when the scores to be aggregated refer to characteristics that are non-cumulative (like those related to subjective well-being); consequently, ad-hoc aggregating approaches need to be identified, especially when individual values can not be aggregated by simply summing up individuals' values.

From the technical point of view, the condensing procedure requires to define significant aggregation units and to adopt techniques allowing the aggregation of individual scores (*aggregating criteria*). Two aggregating criteria can be defined.

A. Homogeneity: the values are aggregated if the individual cases are homogeneous according to the characteristics of interest. The aggregated units produced by this criterion are **typologies** which can be then compared with reference to contextual and background (objective) information; identification of typologies requires analytical approaches allowing homogeneous groups among individual cases to be identified (Aldenderfer, 1984; Bailey, 1994; Corter, 1996; Hair et al., 1998; Lis & Sambin, 1977):

segmentation analysis, which can be conducted through different approaches (*Hierarchical Cluster Analysis, Q Analysis*);

partitioning analysis, which can be conducted through other approaches like *K Means Methods*, *Iterative Reclassification Methods*, *"Sift and Shift" Methods*, *Convergent Methods*;

tandem analysis, which is realized by combining Principal Components Analysis and a clustering algorithm; the latter is applied to the scores obtained by the application of the former.

The difficulty in applying this approach lies in the identification of synthetic scores that reveal themselves to be useless in identifying a cluster structure among observed units. In this perspective *Cluster Analysis* can also be combined with *MultiDimensional Scaling* (MDS) (Nardo et al., 2005a, 2005b).

Factorial k-means Analysis, which is realized by combining Principal Components Analysis and one of the

partitioning method (*K Means method*, that is, *not-hierarchical Cluster Analysis*). A discrete clustering model and a continuous factorial one are simultaneously fitted to two-way data in order to identify the best partition of the objects. The partition is described by the best orthogonal linear combinations of the variables (factors) according to the least-squares criterion. This approach has great potentiality since it simultaneously allows two objectives to be reached: data reduction and synthesis, simultaneously in direction of both objects and variables. The factorial k-means analysis applies a fast alternating least-squares algorithm that extends its application to large data sets (Nardo et al., 2005a, 2005b).

Each analytical approach produces results that vary according to the decisions made in terms of:

1. selected indicators;
2. measures used in order to evaluate proximities between individual-points;
3. method used in order to assign an individual-points to a group;
4. criterion used in order to determine the number of groups;
5. criterion used in order to check the interpretability of the groups.

Each typology will be considered in the context of the successive higher-level analysis in terms of

1. categorical information to which other information can be associated, like the dimension of the group,
2. simple descriptive statistics, univariate (mean, median) or multivariate (centroid).

B. Functionality: the values are aggregated if the individuals belong to pre-existent higher-level units defined in terms of **groups** (social, generational, etc.), **areas** (geographical, administrative, etc.), **time periods** (years, decades, etc.). If the subjective information is collected from a probabilistic sample, it is possible to take into account the weight that each sampled individual has with reference to the correspondent population by assigning a differential weight. The matter is dealt with statistical approaches related to inference methods and sampling techniques. This kind of aggregation requires particular attention since the application of the traditional statistical averaging techniques does not allow us to highlight the distributional characteristics of each aggregated units, which consequently could not be correctly compared in order to avoid the well-known *ecological fallacy*.[4] Regarding this issue, there are attempts aimed to weight average values by different criteria (Kalmijn & Veenhoven, 2005; Veenhoven, 2005).

Relating variables: analytical approaches

After having

- re-constructed the variables by aggregating elementary indicators according to the different and consistent approaches
- built macro-units by aggregating the micro-units (cases) in order to address information to the identified level of analysis,

the object is to assess the **relating model**, concerning the relationships, conceptually modelled and hierarchically designed, between variables. In this perspective, a proper analytical approach should be identified according to the defined conceptual framework. The feasibility of the different statistical approaches needs to be considered by taking into account their specific assumptions. The goal is to identify a procedure able to yield results, not only statistically valid and consistent with reference to

the defined conceptual framework, but also easy to be read and interpreted at policy level.

Structural models approach

With reference to the causal explanatory perspective, we can refer to *Structural Equation Modeling* (SEM), which, as known, represents a statistical technique for testing and estimating causal relationships using a combination of statistical data and qualitative causal assumptions. SEM is considered a confirmatory rather than exploratory approach. It usually starts with a hypothesis, represented as a model, operationalises the constructs of interest with a measurement instrument, and tests the model. The causal assumptions embedded in the model often have falsifiable implications, which can be tested through data evidence. SEM can also be used inductively by specifying the model and using data to estimate the values of free parameters. Often the initial hypothesis requires to be adjusted in light of model evidence, but SEM is rarely used purely for exploration. SEM models allow unreliability of measurement in the model to be explicitly captured and, consequently, structural relations between latent variables to be accurately estimated. In the ambit of its specific assumptions, this approach can be adopted only in presence of a strong and indubitable conceptual interpretative framework concerning the causal relationships between objective and subjective indicators. In other words, it requires a strong acceptance of the direction of the relation between objective and subjective indicators. Moreover, as shown above, two possible directions can be defined in casual explanation, *bottom-up* and *top-down*, which, however, are not separately able to explain completely the relationships between the observed variables. This means that causal effects can emerge in both directions. Diener

(1984) suggested using both *bottom-up* and *top-down* approaches in order to examine the causal directions. Consequently, the application of the model allowing bi-directional effects to be estimated, has to be carried on with extreme caution (Scherpenzeel & Saris, 1996) and requires longitudinal data and analyses. The caution should increase especially in presence of both objective and subjective indicators. Because of these difficulties, any application of this approach requires a strong conceptualisation of an explanatory model. Otherwise, any result can turn out to be misleading.

Multi-level approach

Multi-level analysis refers to statistical methodologies, first developed in the social sciences, which analyse outcomes simultaneously in relation to determinants measured at different levels (for example, individual, workplace, neighbourhood, nation, or geographical region existing within or across geopolitical boundaries) (Goldstein, 1999; Hox, 1995; Krieger, 2002). This approach can be applied in the perspective of integrating objective and subjective indicators by assuming that people living in the same territory (e.g. city or region) share the same macro-level living conditions (objective quality of life) that contributes together with the micro-level living conditions (objective quality of live) to the subjective well-being. If the conceptual model is clearly specifiable and acceptable with reference to which variables are to be included in the study and at which level, these analyses can potentially assess whether individuals' well-being is influenced by not only "individual" or "household" characteristics but also "population" or "area" characteristics (Krieger, 2002). In fact, this approach assumes that structural characteristics of territories come before individual

living conditions and that both precede subjective well-being. The goal is to describe the relationships between subjective well-being ("outcome" variable), territorial characteristics (macro-level living conditions: socio-economic conditions, demographic trend, and so on) and individual objective characteristics (micro-level living conditions: sex, religion, family composition, level of education, and so on). The general analytical framework could be multiple regression: the subjective well-being is regressed on territorial and individual characteristics. If the goal is to evaluate the importance of territorial characteristics on subjective well-being, we could aggregate individual data at territorial level, but as we know this could result in the well-known *ecological fallacy*. In fact, the correlation between the observations resulting from the multilevel structure (the individuals on the same territory present the same values concerning the territory characteristics) of data make the outcomes of the same territory more homogeneous than those yielded by a random sample of individuals drawn from the whole population. This higher homogeneity is naturally modelled by a positive within-territory correlation among individual level of subjective well-being in the same territory. This problem can avoided by applying a variance component model. In statistics, a *variance components model*, also called *random effect/s model*, is a kind of *hierarchical linear model*. These models (along with generalized linear mixed models, nested models, mixed models, random coefficient, random parameter models, split-plot designs) are part of *multilevel models* (Bryk & Raudenbush, 2002), which are statistical models of parameters that vary at more than one level. These models can be seen as generalizations of linear models (also extendible to non-linear models)[5] and represent more advanced forms of simple linear regression and multiple linear regression. They are appropriate for use with nested data. In particular, they assume that the data describe a hierarchy of different populations whose differences are constrained by the hierarchy. In other words, multilevel analysis allows variance in outcome variables to be analysed at multiple hierarchical levels, whereas in simple linear and multiple linear regression all effects are modelled to occur at a single level. Multilevel analysis generally uses Maximum Likelihood (ML) estimators, with standards errors estimated from the inverse of the information matrix. Computing the ML estimates requires an iterative procedure. (Bryk and Raudenbush, 1992; Goldstein, 1999; Hox, 1995) Even if the multilevel approach presents logic and analytic solutions acceptable from the statistical point of view, this method should be considered carefully in the context of quality of life. For instance, when the territorial characteristics do not affect individuals in the same manner and with the same degree (territorial heterogeneity), some authors (Rampichini & Schifini, 1998) suggest introducing a new level in the hierarchy, represented by individuals within each territory. For example, different clusters of individuals could be identified sharing same living conditions at micro-level. This could lead to results in which similar clusters are in different territories.

Life-course perspective

Life-course perspective refers to a conceptual model that considers well-being status at any given individual state (age, sex, marital status) not only reflecting contemporary conditions but also embodying prior living circumstances. This means that we could try to study people's developmental trajectories (environmental and social) over time, by considering also the historical period in which they live, in reference to their society's

social, economic, political, and ecological context. This approach assumes that some components can exist which can determine an effect, at a sensitive or "critical" period of individual life, lasting, or having a lifelong significance. The interest could be oriented to analysing which of these processes are reversible and which could be the role of objective micro or macro level characteristics in this. This perspective deserves particular attention and consideration. Its limit is mainly represented by the difficulty to obtain detailed and consistent individual longitudinal data and by the complexity of managing, analysing, and modelling this kind of data. According to its characteristics, this approach turns out to be useful in order to study phenomena circumscribable through a clinical logic.

Composite indicators

One of the possible proposals to the integration could be the construction of indicators at a higher level that means that objective and subjective indicators should be aggregated in a unique value referring to each unit of interest (city, country, and so on). This proposal, which proceeds simply aggregating indicators up to a single numeric value, can appear attractive at a first glance but does not reveal to be easy and creates conceptual, interpretative and analytical problems when the aggregation involves measures that are both subjective and objective.

For example, we can consider the standardization issue: in order to create composite indicators, data need to be reduced to a common reference-metric. That is particularly significant when data are measured with reference to different methodologies; for example, individual data do not always meet the requirement of metric measurement (like some objective individual information, for example, family typology); the problem is how to face the issue without adopting sophisticated approaches. In our opinion, this approach could be considered as one the possible solutions for integration.

Traditional explorative approaches, such as clustering and mapping approaches, multidimensional analysis, correspondences analysis (Aldenderfer, 1984; Bailey, 1994; Corter, 1996; Hair, 1998; Lis and Sambin, 1977), should be added to the approaches presented above. The approaches are all practicable but in view of their application their capability to meet assumptions and to fit the needs of the conceptual framework need to be explored.

Framing the complexity: developing systems of indicators

As we have seen, each indicator gains meaning if it is defined in the ambit of a conceptual model that allows the definition and identification of the relationships (i) between indicators, (ii) between each indicator and its corresponding latent variable, and (iii) between latent variables. In this perspective, the use of just a single indicator is meaningless. The set of identified indicators can be seen and managed as a unique system, called system of indicators. Such a system can be utilized for goals both scientific and operative. The system of indicators does not represent a pure and simple collection of indicators. Since its definition is strictly connected to the definition of proper conceptual framework, each indicator measures a distinct constituent of the observed phenomenon and the indicators together provide researchers with information that is bigger than their simple summation. In particular, systems of indicators turn out to be useful when a decision process need to involve a composite and evaluation (policy and technique). In this sense,

Key elements:	• conceptual framework requested in order to identify and justify the selection of dimensions to be measured • system architecture requested in order to support the basic structure and to define measurement procedures • definition and selection of the dimensions to be measured • identification of units to be monitored • organization of measuring and monitoring procedures
Formal criteria to be respected:	• comprehensiveness • consistency • non-redundancy • parsimoniousness

systems of indicators can represent an important and valid support to subjects involved in decision processes. Decision makers need to know and manage a composite mosaic of information in order to define and evaluate priorities to be translated into actions. Since systems of indicators are supporting tools, they cannot define objectives and priorities, evaluate programs, and develop common scale allowing comparisons. A system of indicators can produce meaningful information if it presents the following characteristics of:

- **objectivity**: the results have to turned out to be equal or comparable, independently from who are the users;
- **quantification**: the system has to produce quantitative values obtained through standardized procedures and measures. This allows results to be reported with more precision and detail, and data to be analysed through complex methods;
- **efficiency and fidelity**: methods, techniques and instruments that allowed data and results to be obtained have to be communicated and publicized,
- **economicity**: the system has to produce simple, standardized, available and up-to-datable information;
- **generalization**: the system has to allow its generalization to other similar context (exportability);
- **joint development**: the system has to be developed in a shared way by all the "actors".

The procedure aimed at defining and developing a system of indicators allowing the integration of objective and subjective indicators can be seen as the realization of a study that have to be conducted through several moments and that can be demanding in terms of resources (not only financial) and skills. The basic requirements defining a system of indicators are synthesized by Noll (2004) as follows:

Several risks could be faced in developing a system of indicators, like:

• the set of identified indicators is poor or bad-defined and do not fit the conceptual framework, goals and objectives;

• data are not reliable;

• indicators do not allow local realities to be compared (e.g. explanatory variables are not measured);

• system's results are not able to produce effects on the strategic, decision and planning processes.

Functions of systems of indicators

Systems of indicators can be differentiated with reference to the function (Land, 2000; Noll, 1996; Berger-Schmitt & Noll, 2000) for which they have been created. The different functions can be seen in cumulative terms since each of them requires the previous one/s.

Monitoring. This basic function concerns and refers to capacity of the system to monitor changes over time and meet the need of improving the possibility to:

• identify and clearly define the existing problems,

• draw promptly attention to new problems and to formulate questions,

• control and identify the main critical points of the system,

• measure changes if any (economic, social, etc.).

This function requires timing and frequencies of observation to be defined in order to evaluate any change.

Reporting. In this case the system play an important role of explanation by meeting the need

• *to describe* situation, condition, and dynamics of a certain reality (a country, an institution, etc.); in this perspective, the system answers question like "what is going on?"

• *to analyse* the existing relationships between different components; in this perspective, the system answers questions like "in which way did it happen?"

Description and analysis are strictly related to reporting function, as synthetically represented by Noll (1996; Berger-Schmitt & Noll, 2000)

monitoring + analysis + interpretation = reporting

Forecasting. The systematic use of indicators allows the consequences attributable to change in a series to be documented and consequently to forecast trends in observed reality. This function represents an important part of the explanation function of a system of indicators.

Program/Performance Evaluation. The system represents a valid support to *project management* since it allows specific strategic programmes to be evaluated with reference their realization at the present, their capacity to meet particular and specific purposes, and the prescription of future actions. In the ambit of strategic programmes, indicators must allow the following assessments:

• evaluation of the present state (where are we now?)

• identification of the priorities and the actions to be pursued (where do we want to go?)

• evaluation of adequacy (are we taking the right path to get there?)

• evaluation of progress towards goals and objectives by quantifying the strategic performances (are we there yet? can differences be observed?).

Since these systems are constructed with reference to specific programmes, they can be hardly ever generalized. In this perspective, this important function of systems of indicators can play an important role in policy analysis (policy guidance and directed social change) by allowing problem definition, policy choice and evaluation of alternatives and program monitoring (Land, 2000).

Accounting. A system can represent a useful mean of *accounting*, by which it is possible to measure and make systematically available data supporting decision concerning the allocation and the destination of resources (financial and not only).

Assessment. A system can represent a valid support to evaluation and assessment procedures (certification and accountability). In this case the goal may be to certificate or judge subjects (individuals or institutions) by discriminating their performances or to infer functioning of institutions, enterprises or systems.

Elements defining a system of indicators

Apart from the indicators quality and typologies, the main elements defining a system of indicators are (i) aims, (ii) structure, (iii) analytic approaches, (iv) interpretative and evaluating models (Noll, 1996; Berger-Schmitt & Noll, 2000).

i. Aims. One of the main requirements of a system of indicators is the reference to the aims of its construction.

Concerning this, we can distinguish between:

• *Conceptual aims* (**goals**) that represent broad statements concerning what has to be achieved or which is the problem to be faced. Usually goals are placed at macro level (national, international, etc.).

• *Operative aims* (**objectives**) that represent the instruments identified in order to attain the conceptual aims. Objectives can have different temporal prospects (monthly, four-monthly, annual, bi-annual, etc.)

• *Planning aims* (**actions**) that represent the specific activities identified to accomplish objective. They can include developments and infrastructural changes in policies, in institutions, in management instruments, etc.

All the above goals, objectives and actions have corresponding

1. targets that represent those elements allowing each goal, objective and action to find measurable criteria and to define a *timetable*.

2. particular measures defined in order to assess progress towards the target with goals and objectives and the accomplishment of actions; these **indicators** can be distinguished in:[6]

indicators		function
• input	⇨	measuring resources available in the system and indicating some sort of inputs into a process
• process (intermediate output)	⇨	monitoring the basic progress of implementing the actions defined and outlined at strategic level
• output/outcome	⇨	monitoring direct results of actions
• impact	⇨	monitoring progress and improvement towards goals and objectives achievement

These indicators can be combined in order to define composite measures (efficacy or efficiency indicators).

ii. Structure. The design through which data are systematised defines the structure of the system. The structure can take three different forms. Systems can be consequently:

• vertical, in this case systems require data collection from local levels (e.g. regions) in order to be systematized at a higher level (e.g. country). This kind of system can be used in order to implement policy goals according to local information.

• horizontal, in this case systems require data collection only at one level (e.g. regional) and allow particular observational ambits (environment, education) to be monitored; usually data on subjective characteristics are collected at this level.

• local, in this case system are typically designed in order to be used only in the ambit of local decisional processes. This kind of system is characterized by two levels:

• internal, when the indicators are aimed at monitoring the internal organization of the level;

• external, when the indicators refer to parameters existing at higher levels (e.g. transportation).

iii. Analytic approaches. Indicators have to be placed in an analytic context, consistently with aims and structure. In this perspective, different analytic approaches can be distinguished:

• *trend analysis* the analytic objective is to clarify development trend;

• *monitoring analysis* the analytic objective is to monitor the developments of a specific condition (e.g. environment conditions);

• *reporting analysis* the analytic objective is to report the results as they are obtained in a hierarchical procedure of *decision-making*;

• *benchmarking analysis* the analytic objective is to compare between performances of the considered units (e.g. countries);

• *impact assessment* the analytic objective is to clarify the impacts of planned and undertaken initiatives and actions;

• *evaluation analysis* the analytic objective is to record and evaluate the effects of planned and performed initiatives and actions.

iv. Interpretative and evaluating models. The observed results can be interpreted only according to a specific reference frame. This can also define and identify particular *standard-values*, which can be defined a priori, according to the objectives or empirical observations (e.g. surveys). In certain cases, along with general standards, differential standards can be defined with reference to different groups (e.g. for males and females). Comparisons among groups are possible according to the availability of a unique scale for the observed and standard values.

Characteristics of indicators within a system

In previous paragraphs, some methodological issues concerning definition and construction of indicators have been shown and dealt with. Indicators can find subsequent applications at different operative and applicative levels. In this perspective, indicators should present some characteristics in order to be concretely applicable. Michalos (1992) shows how indicators constructed in the applicative perspective can be useful at different levels (from scientific knowledge to policy level):

• allow the forecast of future trends,

• show and point out social problems,

• help in defining priorities of policies,

• allow territorial comparisons,

• suggest new ambits that need to be study in order to define new theories and a deep knowledge of social structures and functions.

In particular, a [statistical] index can be considered as a [social] indicator when (Land, 1971, 1975):

1. it represents a component in a model concerning a social system

2. it can be measured and analysed in order to compare the situations of different groups and to observe the direction (positive or negative) of the evolution along time (time series analysis)

3. it can be aggregated with other indicators or disaggregated in order to specify the model.

The lack of any logical cohesion should not to be hidden by the use and application of sophisticated procedures and methods that can deform reality through distorted results.

Classification

Each indicator can be classified according to several criteria.

Purposes

The indicators can be distinguished according to their **purpose** that can be:

• *descriptive*, when the indicators are aimed at describing and knowing a particular reality (for example, quality of life). These indicators are said to be informative and baseline-oriented; in other terms, they allow changes along time, differences between geographical areas, and connections between social processes to pointed out;

• *explicative*, when the indicators are aimed at interpreting reality;

• *predictive*, when the indicators help to delineate plausible evolutional trends that is possible to describe in terms of

development or decrement; these indicators require strong prediction models and continuous observations along time;

• *normative*, when the indicators are aimed at supporting, guiding, and directing decisions and possible interventions (policies) concerning problems to be solved. The normative function needs the definition of particular referenced standards defined in terms of time, territory, etc.; the reference values allow to evaluate the attainment of defined goals;

• *problem-oriented*, when the indicators are defined as a function of a specific hypothesis of research and analysis aimed at identifying contexts, kinds, severities of specific problems (for example the lack of quality of life conditions among immigrants);

• *evaluating*, that can be distinguished in

1. practical: indicators interfacing with observed process (e.g. in an organization),

2. directional: indicators testing if the observed condition is getting better or not,

3. actionable: indicators allowing change effects to be controlled.

Governance contexts

The indicators can be distinguished according to the **context** in which they are created, used, and interpreted. In this perspective, we can identify different contexts. For example:

1. public debates: in this case the indicator/s have the function of informing, stimulating, forming and developing particular sensitiveness;

2. policy guidance: in this case the indicators/s can support particular policy decisions;

3. administrative guidance: in this case the indicator/s can support the evaluation of the different impacts of different alternatives.

Perspectives of observation

The indicators can be distinguished according to the different **perspectives of observation.** For instance, in the ambit of quality of life, a complex indicator that measures through:

• a *conglomerative* approach measures overall well-being, where increases in well-being of the best-off can offset decreases in well-being of the worst-off;

• a *deprivational* approach measures only the welfare of the worst-off (Anand & Sen, 1997).

Anand and Sen (1997) arguing that the conglomerative and deprivational perspectives are not substitutes for each other, proposed a *complementary* approach. "We need both, for an adequate understanding of the process of development. The plurality of our concerns and commitment forces us take an interest in each". The adoption of complementary approach allows us to construct indices of social and economic well-being that should reflect the aggregated and disaggregated approaches. According to this methodology, conglomerative and deprivational indices should be constructed separately side-by-side along the lines of the United Nations Development Programme indicators (Sharpe & Salzman, 2004).

Forms of observation

The indicators can be distinguished according to the different **forms of observation.** In this perspective we can distinguish between:

• *status indicators*, which measure the reality in a particular moment; they allow for cross-comparisons between different realities. These indicators can produce cross data that need to be carefully managed since not the different realities can

not always be directly compared; this is particularly true in the case of subjective characteristics observed in different geographical, social, cultural, political, environmental, and administrative conditions;

• *trend indicators*, which measure reality along time; they require a defined longitudinal observational design (for example, repeated surveys on particular populations). These indicators can produce *time series* that need to be carefully managed since the observed moments could reveal themselves to be incomparable and/or the defined indicators could reveal themselves as non applicable after some time.

Levels of communication

The indicators can be distinguished according to the different **levels of communication.** It regards the target group to which the final indicator will be communicated. In this perspective, indicators can be classified in:

• *cold indicators*: in this case, the indicators have a high level of scientific quality and show a high level of complexity and difficulty;

• *hot indicators*: in this case, the indicators are constructed at a low level of difficult and show a high level of understanding. It is unusual for these indicators to be used in a policy context;

• *warm indicators*: in this case, the indicators show a good balance between quality, comprehensibility, and resonance.

Quality

Many international institutions, like World Bank & Unesco (Patel et al., 2003) and Eurostat (2000) tried to identify the attributes of **quality** that any indicator (and as we will see any approach aimed at their management) should possess and need to be considered in the process of developing of new indicators or of selecting available indicators.

(I) Methodological soundness. This characteristic refers to the idea that the methodological basis for the production of indicators should be attained by following internationally accepted standards, guidelines, or good practices. This dimension is necessarily dataset-specific, reflecting different methodologies for different datasets. The elements referring to this characteristic are (i) concepts and definitions, (ii) scope, (iii) classification / sectorisation, and (iv) basis for recording. Particularly important is the characteristic of **accuracy and reliability**, referring to the idea that indicators should be based upon data sources and statistical techniques that are regularly assessed and validated, inclusive of revision studies. This allows accuracy of estimates to be assessed. In this case accuracy is defined as the closeness between the estimated value and the unknown true population value but also between the observed individual value and the "true" individual value. This means that assessing the accuracy of an estimate involves analysing the total error associated with the estimate: sampling error and measurement error.

(II) Integrity. Integrity refers to the notion that indicator systems should be based on adherence to the principle of objectivity in the collection, compilation, and dissemination of data, statistics, and results. The characteristic includes institutional arrangements that ensure (i) professionalism in statistical policies and practices, (ii) transparency, and (iii) ethical standards.

(III) Serviceability. Comparability is a particular dimension of serviceability. It aims at measuring the impact of differences in applied concepts and measurement tools/procedures over time, between geographical areas, between domains.

(IV) Accessibility. Accessibility relates to the need to ensure.

(i) clarity of presentations and documentations concerning data and metadata (with reference to information environment: data accompanied with appropriate illustrations, graphs, maps, and so on, with information on their quality, availability and eventual usage limitations)

(ii) impartiality of access

(iii) pertinence of data

(iv) prompt and knowledgeable support service and assistance to users

In other words, it refers also to the physical conditions in which users can obtain data: where to go, how to order, delivery time, clear pricing policy, convenient marketing conditions (copyright, etc.), availability of micro or macro data, various formats (paper, files, CD-ROM, Internet…), etc.

Prerequisites of quality

Although it does not represent a dimension of quality in itself, prerequisites of quality refers to institutional preconditions and background conditions for quality of statistics. These prerequisites cover the following elements: (i) legal and institutional environment (including coordination power within and across different institutions), (ii) resources available for statistical work, and (iii) quality awareness informing statistical work.

Problems in selecting indicators

Different issues need to be addressed in order to selecting and managing indicators, especially when this is carried out into a complex system allowing the accomplishment of functions like monitoring, reporting and accounting. Michalos (in Sirgy et al., 2006) identified 15 different issues related to the combination of social, economic and environmental indicators. As Michalos asserts, the issues collectively yield over 200,000 possible combinations representing at least that many different kinds of systems (Sirgy et al., 2006):

• Settlement/aggregation area sizes: e.g., the best size to understand air pollution may be different from the best size to understand crime.

• Time frames: e.g., the optimal duration to understand resource depletion may be different from the optimal duration to understand the impact of sanitation changes.

• Population composition: e.g., analyses by language, sex, age, education, ethnic background, income, etc. may reveal or conceal different things.

• Domains of life composition: e.g., different domains like health, job, family life, housing, etc. give different views and suggest different agendas for action.

• Objective versus subjective indicators: e.g., relatively subjective appraisals of housing and neighbourhoods by actual dwellers may be very different from relatively objective appraisals by "experts".

• Positive versus negative indicators: negative indicators seem to be easier to craft for some domains, which may create a biased assessment, e.g., in the health domain measures of morbidity and mortality may crowd out positive measures of well-being.

• Input versus output indicators: e.g., expenditures on teachers and school facilities may give a very different view of the quality of an education system from that based on student

performance on standardized tests.

• Benefits and costs: different measures of value or worth yield different overall evaluations as well as different evaluations for different people, e.g., the market value of child care is far below the personal, social or human value of having children well cared for.

• Measurement scales: e.g., different measures of well-being provide different views of people's well-being and relate differently to other measures.

• Report writers: e.g., different stakeholders often have very different views about what is important to monitor and how to evaluate whatever is monitored.

• Report readers: e.g., different target audiences need different reporting media and/or formats.

• Quality-of-life model: e.g., once indicators are selected, they must be combined or aggregated somehow in order to get a coherent story or view.

• Distributions: e.g., because average figures can conceal extraordinary and perhaps unacceptable variation, choices must be made about appropriate representations of distributions.

• Distance impacts: e.g., people living in one place may access facilities (hospitals, schools, theatres, museums, libraries) in many other places at varying distances from their place of residence.

• Causal relations: prior to intervention, one must know what causes what, which requires relatively mainstream scientific research, which may not be available yet.

Choices and options selected for each issue have implications for the other issues. The issues are not mutually exclusive and are not expected to be exhaustive as other can be identified. Dealing with these issues is merely a technical problem to be solved by statisticians or information scientists. On the other side, the construction of indicators of well-being and quality of life is essentially a political and philosophical exercise, and its ultimate success or failure depends on the negotiations involved in creating and disseminating the indicators, or the reports or accounts that use those indicators. (Michalos, in Sirgy et al., 2006)

Notes

1. In this context, we avoid the alternative definition of social epidemiology as "the branch of epidemiology that studies the social distribution and social determinants of states of health" (Epidemiological Bullettin, 2002).

2 In data analysis, indicators/items are technically defined "variables"; consequently, these are conceptually different from "latent variables."

3 As pointed out, the proposed model is conceptually related to latent structural models that find analytical solutions through the application of the structural equations method (Asher, 1983; Bartholomew & Knott, 1999; Blalock, 1964, 1974; Bohrnstedt and Knocke, 1994; Lazarsfeld & Henry, 1968; Long, 1993a, 1993b; Maggino, 2005a; Netemeyer et al., 2003; Saris, 1990; Sullivan & Feldman, 1981; Werts, 1974).

4 Aggregation of scores collected at micro levels is a well-known issue in many scientific fields, like economics and informatics, where particular analytic approaches are applied (like the probabilistic aggregation analysis). In econometric fields, particular empirical methodologies have been developed, allowing the explanation of systematic individual differences (*compositional heterogeneity*) that can have important consequences in interpreting aggregated values (Stoker, 1993).

5 Multilevel analysis has been extended to include multilevel structural equation modelling, multilevel latent class modelling, and other more general models.

6 Another non-alternative classification is that that distinguishes with reference to their polarity, *positive* or *negative* quality of life observations (see the contribution to this by Alex Michalos in Sirgy et al., 2006).

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